APPENDIX B

CONFERENCE ON THE FULL SOCIAL COSTS AND BENEFITS OF TRANSPORTATION

A comprehensive description of the U.S. transportation system should include answers to a number of broad and open-ended questions: What are the important measures of the performance of transportation? Is the system's performance getting better or worse? What is the relative magnitude of the problems to be addressed and how much of society's resources should be devoted to solving them? Is the transportation system efficient? Does it satisfy our standards for equity and social justice? Who pays and who benefits?

In July 1995, the Bureau of Transportation Statistics (BTS) held a conference on measuring the full social costs and benefits of transportation. BTS brought together an international group of transportation researchers and analysts from government, industry, academia, and nonprofit institutions. (The list of conference participants is presented at the end of this appendix.) Its purpose was to define concepts and advance the state-of-the-art for estimating, analyzing, and interpreting the social costs and benefits of transportation and to assist BTS in developing useful measures of transportation's consequences. BTS, whose mission is to compile, analyze, and make accessible information on the nation's transportation system, has a mandate to advance comprehensive understanding of transportation's role in society and its effects on the environment.[1] The conference was part of this process.

[1] Section 6006 of the Intermodal Surface Transportation Assistance Act of 1991 established BTS.

T.R. Lakshmanan, Director of BTS, identified three types of information needed to measure transportation's full costs and benefits.

1. General and comprehensive **performance indicators** for the transportation system.
2. Measures of transportation's **contribution to the economy.**
3. Measures of the **unintended consequences** of transportation, including external costs.

Fourteen papers were presented on several topics, including social costs and economic efficiency, total costs and benefits, and issues in measuring the full cost of transportation. These papers have been peer reviewed and will be published by Springer-Verlag in late 1996. (The list of papers is presented at the end of this appendix.)

This appendix presents an overview of the topics addressed at the conference. Emphasis was given to theoretical and conceptual issues, which form the foundation for measuring and evaluating full social costs and benefits. Three broad motivations for measuring full social costs and benefits were identified. Each of these motivations can lead to different concepts and measures of costs and benefits.

1. To **compare alternative situations.** Comparisons could be as hypothetical as comparing greenhouse gas emissions under alternative scenarios or as concrete as analyzing the full range of costs and benefits of a major infrastructure investment.
2. To **evaluate the economic efficiency** of transportation, particularly in assessing the external costs and benefits that are not reflected in the price of transportation.

3. To address **fairness and equity issues,** including horizontal equity and vertical equity concepts. The horizontal equity concept addresses whether those who benefit from transportation infrastructure pay appropriately for it. The vertical equity concept examines whether various segments of society such as the poor, aged, or handicapped receive adequate benefits from public expenditures and investments in transportation.

The conference also focused on empirical issues in full cost estimation, such as how to measure the economic costs of air pollution, how to quantify traffic congestion costs, and how to account for infrastructure costs when valuing the costs of oil dependence. Much of the discussion dealt exclusively with external costs, reflecting current interests and practices of researchers. Participants noted, however, that future research must also focus on how to fully measure the benefits of transportation.

Finally, the conference addressed the implications of full costs and benefits issues. Conferees noted the need to give equal weight to identifying and measuring benefits and the importance of understanding the dynamic spatial effects of transportation systems. Discussions centered on alternative views of transportation as a provider of accessibility or of mobility and the implications of substitution and complementarity of transportation and telecommunications. Although there were many areas of agreement, many important areas of disagreement or uncertainty remain. These include the relevance and importance of external or social benefits of transportation, conceptual uncertainties about which costs and benefits are or are not external to private decisionmaking, and whether relevant costs and benefits can be adequately characterized as externalities. In general, substantial theoretical and methodological questions remain about what needs to be measured and how.

Why Measure Full Social Costs and Benefits?

In 1994, the U.S. transportation system carried travelers more than 4.2 trillion miles and in 1993 hauled 3.7 trillion ton-miles of freight. Not surprisingly, it comprises a major share of the economy. As noted in chapter 2, transportation produces about 11 percent of the U.S. gross domestic product ($712.7 billion in 1994). One in every 10 Americans (12.4 million) are employed in transporting people or goods, manufacturing, selling, or maintaining transportation vehicles and infrastructure, or supplying other critical elements of the transportation system. Yet the influence of transportation on society is even more pervasive than these numbers suggest.

Transportation technologies shape the geography of society by influencing the location and intensity of land uses. Changes in land use, in turn, have far-reaching effects on patterns of production and consumption. The cost and speed of transportation are major determinants of the density of development. Fast, low-cost transportation has supported the increasing independence of home and workplace locations.

The U.S. transportation system has large unintended consequences. In the United States, 43,750 lives were lost and over 3.25 million people were injured in transportation accidents in 1994. In the 50 largest U.S. cities, traffic congestion and delays in 1991 resulted in estimated total economic losses of over $45 billion.[2] Motor vehicles produce from one-third to four-fifths of the major constituents of urban air pollution. Especially in cities, transportation vehicles are a major source of unwanted noise. The transportation sector accounts for two-thirds of total U.S. oil consumption and hence contributes to our

[2] Schrank et al. (1994, table 35) assumed a vehicle occupancy rate of 1.25, calculated in 1994 dollars.

nation's dependence on oil imports. Finally, the combustion of fossil fuels by transportation produces about one-third of U.S. greenhouse gases, which have the potential to alter the world's climate in the next century. Given transportation's importance to society, it is reasonable to ask whether these unintended consequences have been appropriately taken into account in market decisions and public policy initiatives.

All levels of government play important roles in our nation's transportation system. Governments invest in highways, airports, and other infrastructure for all transportation modes. They promulgate and enforce rules and regulations that sometimes encourage and at other times discourage competition throughout the sector. Government regulations on public safety and the environment have been the primary mechanisms for dealing with the unintended social costs of the transportation system.

Conceptual Frameworks for Measuring and Valuing Social Costs and Benefits

Most of the literature on full social costs of transportation attempts to address negative externalities—the unintended damage imposed on others that is not reflected in the price of a good or service. For example, pollution emitted from a motorist's automobile is not fully reflected in the costs of owning and operating a vehicle. Thus, this cost is said to be external to a motorist's economic decisionmaking. (The motor vehicle pollution example is treated in greater detail in chapter 6.) Other acknowledged transportation externalities include surface and groundwater pollution, noise, greenhouse gas emissions, traffic congestion, and impacts on land use and wildlife habitats.

Economists have recognized for decades that negative externalities cause markets to arrive at "inefficient" production and consumption decisions from the standpoint of the greatest possible social welfare. (Pigou 1938) Using the motor vehicle pollution example, the market, acting without public policy intervention, would use overly polluting technology to produce more travel than might otherwise occur, which would then have an adverse impact on clean air.

It is useful to measure the damages done by transportation externalities in order to know whether more, or less, should be done. If it is found that more needs to be done, actions could be considered to encourage markets to recognize and account for external costs. Such measures are sometimes said to "internalize" externalities. For example, some economists propose a tax on negative externalities, on the theory that such measures might promote market decisions that would achieve greater social benefits. In many situations, however, directly taxing an externality is not politically feasible and is difficult to levy and implement. Thus, other public policy actions may be more practical. These include establishing standards for the production of externalities or taxing activities related to the production of externalities.

As chapter 7 demonstrates, public policy tools have been widely used to deal with the environmental impacts of transportation. For more than three decades, increasingly stringent regulations have limited motor vehicle emissions. Regulations also define allowable noise limits for aircraft and require the repair of leaking fuel storage tanks. To some degree, these measures have resulted in the internalization of some externalities. Internalization of the full range of external environmental costs, however, has seldom, if ever, been achieved. Moreover, some of the most significant nonenvironmental costs of transportation, such as traffic congestion, have been largely unaddressed by public policy. (National Research Council 1994)

This and other issues concerning the implications of external costs for economic efficiency

were addressed by conference participants. Motor vehicle exhaust emissions were used as an example of an external cost that is difficult to tax directly. Although emissions control technology is a standard feature of all U.S. cars, improperly functioning emissions control technology can cause the rate of emissions per mile to vary by an order of magnitude. In addition, recent research shows that driving practices (e.g., speed, acceleration) greatly affect emissions rates of all vehicles. Furthermore, the damages done by emissions vary over time and space. The effect of emissions on air quality changes with the season and with the concentration of other pollutants already present. The damage done by poor air quality depends on the number of people exposed and their initial health, as well. Rather than attempting to directly tax the external costs of motor vehicle emissions, current policies set regulatory standards for emissions from new vehicles and the composition of fuels.

Regulatory standards affect the rate of emissions per mile, but have little direct effect on the number of miles traveled. (To the extent that the cost of pollution control equipment is passed on to the car buyer, regulations will affect the size of the vehicle stock, scrappage rates, and other factors that indirectly affect the amount of vehicle travel.) Ideally, to achieve the greatest social benefit, both the rate and quantity of emissions must be adjusted. Theoretically, regulatory standards, when used, could be set at such a level to achieve a $1 reduction in damages from the last $1 spent on control equipment. Even this step would be unlikely to completely eliminate pollution by motor vehicles because external damages continue to be created by vehicle-miles traveled. Theoretically, an economically efficient outcome could be achieved if a tax were imposed on vehicle-miles at a rate equal to the remaining external cost per mile. It was pointed out that even if regulations were too stringent, that is, they required more emissions controls than were justifiable based on the reduction of external costs, a tax on vehicle-miles equal to the remaining external cost per mile would still result in an economically efficient outcome from a social benefits standpoint. Thus, even when emissions control regulations are in place, information on the external costs of transportation is still relevant for two purposes: 1) to evaluate the cost-effectiveness of the regulatory standards, and 2) to assess whether the price of travel adequately internalizes the remaining external costs.

Per-mile damage estimates vary greatly by vehicle type and level of emissions control. It is clear that dramatic reductions in per-mile damages have been made, and still further reductions are possible. For example, one report estimated damages of 6.6 cents per mile for a 1977 model year car, compared with half the damages (3.3 cents per mile) produced, on average, by 1992 automobiles. (Small and Kazimi 1995) Vehicles meeting California's new car standards for 1993 were estimated to generate ½ cent per mile in pollution damage; low-emission vehicles and ultra-low-emission vehicles produce only ¼ cent per mile in pollution damages. It is important to note that these estimates are highly uncertain.

Damage estimates from motor vehicles in one city cannot be applied uniformly to cars in all cities. Los Angeles, for example, has the worst pollution in the United States and may have the greatest share of pollution caused by motor vehicles. Also, internalizing air pollution costs would have a noticeable impact on vehicle travel in the Los Angeles region today, but that impact would decrease in the future.

All costs of transportation not directly paid for by transportation users are not necessarily externalities, an important point sometimes overlooked in studies of the full social costs of transportation. The conference addressed the question of what is and is not an externality. Discussions focused on recent studies that examined off-street free parking, accidents, and

energy security as external costs. It was noted that free parking provided by employers and retail stores was a case of product bundling rather than external costs. (Lan and Kanafani 1993) For example, if one goes to a shopping mall to buy a shirt, the cost of the free parking provided is paid for in the price of the shirt. Because all shoppers pay the same price for the shirt, regardless of their use of parking, one can argue that shoppers who do not use parking subsidize those who do. In this example, the issue is whether it is more appropriate to view free parking as an external cost, or as a form of price discrimination by a shopping mall that provides a bundled benefit that is valued by some customers but not others. Whether or not this form of price discrimination seriously affects economic efficiency depends on how much it distorts transportation decisions and on the consequences of those distortions.

The view that transportation accident costs are externalities was also questioned at the conference. For example, drivers assume a safety risk and impose a safety risk on others (both personal and property damage apply). If motorists systematically underestimate the risks to themselves, then the failure would appear to be caused by imperfect information or possibly irrational behavior, rather than a case of external cost. The risk to others may be reflected in the cost of liability insurance and by the potential to be held legally liable for damages to others. There is some evidence to suggest that insurance and legal actions do not fully compensate for damages caused by motor vehicle accidents. Estimates of the total costs of motor vehicle accidents were presented at the conference. One estimate indicated that from one-quarter to one-third of the total costs of motor vehicle accidents were borne by society as a whole and not by those involved in the accidents. This suggests that costs imposed on others by transportation accidents are very substantial and not accounted for in private individuals' travel decisions. Tangible and intangible losses to surviving family members are large components of this estimate. Whether such costs should be classified as externalities has been the subject of debate.

More than one-quarter of all drivers in fatal highway crashes have at least some alcohol in their systems. Although drunk drivers impose enormous costs on others, it is not clear that this problem is best viewed as a case of external costs. Some argued that drunk driving is an inherently irrational behavior and may therefore fall outside the realm of welfare economics.

The cost of oil dependence has been classified as an external cost of transportation in several studies. It may be more appropriately regarded, however, as a different kind of economic problem. Recent studies have adopted sometimes internally inconsistent perspectives on the cost of oil dependence. Some have included military and strategic petroleum reserve costs in their analyses. Others view the problem primarily as an exercise of monopoly power by the Organization of Petroleum Exporting Countries (OPEC), resulting in price shocks and generally higher oil prices to the United States. From this perspective, the problem is not so much that the consumption of an additional barrel of oil increases OPEC's market power (though part of the problem can be viewed this way), but rather that OPEC has partial monopoly power in world oil markets in the first place. Using this interpretation, the source of economic inefficiency is the lack of full competitiveness in world oil supply and not an externality associated with the consumption of oil.

External costs like environmental pollution are a significant source of inefficiencies in transportation markets, but not the only source. Imperfect competition, inadequate or inaccurate information or perceptions, and irrational behavior all appear to be significant sources of economic inefficiency. In the case of free parking, the fact that a service for transportation users is partially paid for by others may or may

not be economically inefficient. Certainly, all social costs of transportation are not externalities. Some can be attributed to other types of market failures while still others appear to fall substantially outside the realm of economic behavior. Each has different implications for public policy.

Social Benefits of Transportation

What are the full social benefits of transportation? Typically, this question elicits the response, "Compared to what?" Indeed, it is meaningless to compare the current transportation system to none at all. In doing a comparison, two questions need to be answered: what benefits should be considered, and how should they be measured. Again, the appropriate answers depend on the context of the questions. If the concern is economic efficiency, then external benefits (benefits that accrue to individuals who are neither buyers nor sellers of transportation) must be addressed. If the context is measuring the performance of transportation or evaluating infrastructure investments, then the full range of benefits, external or not, may be included. Admittedly, the benefits of transportation were not adequately addressed at this conference. Indeed, many participants strongly urged that any future conference should devote equal time to understanding the full social benefits of transportation.

Just as with external costs, the existence of external benefits of transportation would tend to cause an inefficient use of society's resources. There appears to be a general consensus among transportation researchers that external benefits created by the additional use of the transportation system are negligible. (Button and Nijkamp 1994) Instances when driving or flying another mile, or shipping another ton of freight, will generate meaningful benefits for parties other than the buyer and seller of transportation services are truly minor. Therefore, there seems little reason to worry that the existing transportation infrastructure will not be adequately used because of external benefits.

On the other hand, many agree that there are significant external benefits attributable to transportation infrastructure, such as roads, railways, airports, and ports. In the United States, the major impact of transportation infrastructure improvements is on economic development. By reducing the costs of obtaining goods and services, transportation improvements increase demand, which leads to economic growth. In this way, transportation improvements confer benefits on users and nonusers alike.

There are other less direct but no less important effects. One participant noted that transportation improvements can lead to increased competition among firms in different geographical locations, producing greater economic efficiency overall. For example, reductions in transportation costs could transform the pricing policies of firms from monopolistic to competitive by removing separation in space as a barrier to competition. Also, expansion of transportation infrastructure can enhance competition among producers with fixed geographic locations and may expand competition among transport firms as well.

The completion of the Interstate Highway System, the development of a widespread network of airports, and the development of intermodal systems served to intensify competition within and among freight modes. Greater competitiveness within the freight industry facilitated the move to deregulate transport modes, leading to additional efficiency gains. "Just-in-time" production is an example of how improved transportation services can change the organization of production, permitting more efficient production practices. Research that explicitly measures the benefits of such mechanisms is scarce, however. As a result, we have few insights into how such

benefits should be incorporated into infrastructure investment decisions.

Advances in transportation technology and infrastructure can enable a transformation of methods of production and consumption. The effect of the automobile on American society is undoubtedly the best known and most studied example of the transformational effect of transportation technology. Yet, there are many others, from steamships and canals to railroads to jet aircraft. Each changed not only the cost of passenger travel and freight transport but also the geography and nature of production and consumption. In the last century, canals and railroads helped open up the West, accelerating westward migration and creating opportunities for economic development.[3] In general, transportation alone does not cause change, but transportation in concert with other technologies does. Railroads, in combination with the telegraph, made it possible to direct and control business enterprises from afar, enabling the creation of the modern corporation. In the past few decades, the combination of new information technologies and transportation logistics have produced major structural changes in production, replacing inventories and buffer stocks with just-in-time deliveries of customized products produced by agile manufacturing.

The fact that a great deal of transportation infrastructure is provided by governments as a public good is sometimes a source of confusion about the existence of external benefits. Strictly speaking, because public goods are not provided by markets, any external benefits can only be external to public decisionmaking. In other words, if a government took into account the benefits to economic development from building a new road, then the benefits cannot be considered external. If a government did not, then the benefits are external. In either case, the benefits still exist. By ignoring them, however, the government is likely to build too few roads.

Who Pays for Transportation?

Who pays for the costs of the transportation system and who benefits are questions that have frequently led to a muddling of economic efficiency and equity issues.[4] Intuition may suggest that an efficient system for financing transportation infrastructure and charging for its use would also be a fair system, but this is not necessarily the case. There are many possible concepts of equity, but most include the notions that beneficiaries should pay a fair price for what they receive and that when damage is done to others, the perpetrators should compensate the victims. While the strategy of taxing external damages to correct for market failure is somewhat similar to concepts of equity, in general the criteria for economic efficiency and social justice are not identical. It may seem just that motorists pay the full cost of damages done by the air pollution they create. Economic efficiency, however, requires that they pay the marginal cost (the cost of damage done by the last unit of pollution produced) for every unit of pollution.

Assuming highways, airports, and other transportation infrastructure are considered public goods, it is not clear that users should always pay the full cost of these facilities. Several participants pointed out that the economically efficient provision of public goods does not require that users pay the full cost of public facilities. Rather, efficiency requires only that the correct amount and appropriate type of transportation

[3] For a detailed discussion of the role of transportation in the U.S. economy, see *Transportation Statistics Annual Report 1995*, Part II: The Economic Performance of Transportation. (USDOT BTS 1995b)

[4] For example, a recent study by the European Federation for Transport and Environment (Kågeson 1993) defines internalization of transportation's social costs as making those giving rise to the damage and injuries financially liable by levying commensurate taxes or other charges on them. This and several other studies (Diekmann 1995; Litman 1994; and Hook 1994) also assert that all infrastructure costs should be paid by users in order to ensure efficient supply of transportation.

be provided. Who pays for public goods can be a matter of equity, but it is not a question of efficiency. Moreover, determination of the efficient amount must take into account the willingness of all economic agents to pay, whether or not they are users. Thus, if a retail store is willing to pay for transportation improvements because demand for its products will increase, or if firms are willing to pay because labor costs will decrease, businesses' demands for transportation infrastructure must be included.

Furthermore, according to one definition of fairness (known as Lindahl fairness), all agents should be taxed according to their demand for public infrastructure, whether they are users or not. In the United States, for example, transportation user charges directly pay for about 75 percent of the expenditures on transportation by all levels of government. (USDOT BTS 1995a) In this light, using real estate or sales taxes to pay part of the cost of highways or public transport is no longer an obvious subsidy; it could possibly be a Lindahl fair charge for a public good. Much theoretical and methodological, as well as empirical, work remains to be done before these issues can be sorted out.

How one defines the meaning of costs and payments and user and nonusers can make a difference between concluding that transportation users (or beneficiaries) do or do not pay their fair share of systems' costs. European studies have shown that because of high motor fuel taxes, transportation users (defined as travelers and shippers) generally pay more in taxes than governments spend on building, maintaining, and operating highway systems. The inclusion of external costs and subsidies (the definition of which is also a topic of debate) can, however, reverse the conclusion.

Evaluating Transportation System Performance

Measures of the full social costs and benefits of transportation should inform us about the role of transportation in society in a variety of ways. Full cost and benefit measures should tell us how the system is performing: are problem areas improving, are benefits increasing? They should also inform us about the relative sizes of problems and benefits of the transportation system in general. In addition, full costs and benefits measures can be useful in understanding questions of equity—the distribution of burdens and benefits to different groups within the population. Finally, cost and benefit measures can provide critical information about the effects of public policies on the efficiency of the transportation system. As economic theory instructs, however, efficiency is determined by conditions at the margin—the costs and benefits of the next unit of transportation activity—rather than total or average costs and benefits.

The final session of the conference discussed how BTS could develop improved measures of transportation's full range of costs and benefits. BTS reiterated its priorities for improving a knowledge base to support its information gathering and analytical activities. Measures of full costs and benefits were identified as indicators of the performance of the transportation system. Three categories of indicators were highlighted as the agency's priority: 1) inputs (what goes into the production of transportation), 2) outputs, and 3) outcomes (did the outputs really achieve the desired results?). Currently, most of the data available describe the supply of transportation (the outputs). There are fewer data on the performance of transportation (the out-

comes), a situation that must be remedied. In particular, better measures of the economic contribution of transportation are needed. Finally, society needs better indicators of the unintended consequences of transportation, such as injuries, deaths, and related costs, environmental impacts, and energy dependence.

Conclusion

The need to develop a better understanding of the full benefits of transportation was widely supported by conference participants. Several participants pointed out that what might be called the products of transportation have not been well defined or measured. For example, is the key output of passenger transportation mobility per se, or access to opportunities such as employment, health care, recreation, shopping and social visits? Since locational decisions have consequences for transportation and vice versa, one suggestion was that BTS work on developing accessibility and mobility measures that recognize the relationship between transportation outputs and the geographical context in which they occur.

Conference participants also generally agreed on the need to better understand and measure the transformational effects of transportation technology and infrastructure. For example, what role did investments in transportation infrastructure, such as the Interstate Highway System, jet airports, and intermodal terminals, play in increasing competition among and within transportation modes, thereby making it possible to largely deregulate transportation in the United States. Not only would it be useful to describe and measure such effects, but also to be able to predict the transformational effects of public infrastructure, research and development, and regulatory policy. The coming revolution in intelligent transportation systems, for example, is almost certain to have transformational effects throughout the economy. Is it possible to fully assess the benefits and costs of such a change without understanding its transformational effects?

The panelists agreed there was a need to clarify concepts of equity and to distinguish them from evaluations of economic efficiency. Transportation and the mobility that it provides play a critical role in enabling participation in the economic mainstream. The fact that about 11 percent of all U.S. households and an even higher percentage of black and Hispanic households (30 percent and 19 percent, respectively) do not own a motor vehicle creates a vertical inequity with respect to access to public highway infrastructure and its related benefits. (Pisarski 1996) If equity is recognized as an issue in its own right, apart from economic efficiency, then several criteria must be used to determine fairness in transportation. Whether or not transportation users pay the full cost of transportation is only one factor in determining equity.

Moreover, better information about the full costs and benefits of both transportation infrastructure and its use are likely to be critical to reaching efficient and equitable transportation decisions. Innovations in the technologies of vehicles and fuels will alter relationships between transportation activities and air pollution, noise, and other environmental impacts. Technological changes in vehicles and infrastructure will also alter relationships between travel and safety risks. Technologies now emerging could be used to implement sophisticated road pricing schemes, creating the potential for correcting inefficiencies due to externalities such as traffic congestion and motor vehicle emissions. Whatever changes occur in the transportation system, the need to consider a full range of costs and benefits in public decision-making will continue.

Around the world, transportation researchers are engaged in an ambitious effort to understand

the full effects of transportation on society in order to quantify its full costs and benefits. The impetus for this endeavor derives from the significant impacts of transportation on the environment and on society and from governments' central roles in providing transportation infrastructure and regulating transportation systems. To date, most studies of full costs and benefits focus on costs rather than benefits and are predominantly concerned with issues of economic efficiency. The papers presented at this conference reflected this fact. Yet the conference also served to point researchers in new directions, recognizing that full benefits are equal in importance to full costs. Moreover, full cost and benefit measures are not only relevant to issues of economic efficiency but also are important and meaningful indicators of the overall performance of the transportation system. The conference challenged researchers to help develop the concepts and theory necessary to derive a comprehensive set of performance indicators for transportation and to create methods for measuring them.

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Papers Presented at the BTS Conference on Measuring the Full Social Costs and Benefits of Transportation

- David Anderson and Herbert Mohring, University of Minnesota, "Congestion Costs"
- Ulrich Blum, Dresden University of Technology, "What Benefits of Transportation Must Be Considered and When?"
- Mark A. DeLucchi, University of California, Davis, "The Critical Issues in Full Cost Estimation"
- A. Myrick Freeman III and William D. Shipman, Bowdoin College, "Residual Damages, Surrogate Taxes and Economic Efficiency"
- David Gillen, University of California, Berkeley and Wilfrid Laurier University, "Efficiency and Transportation Infrastructure"
- José Gomez-Ibañez, Harvard University, "Pitfalls in Defining Externalities"
- David L. Greene and Donald W. Jones, Oak Ridge National Laboratory, "Measuring the Full Social Costs and Benefits of Transportation"
- David A. Hensher, University of Sydney, "Travel Time Costs"
- Alan J. Krupnick, Resources for the Future, "Costs of Air Pollution"
- Douglass Lee, U.S. Department of Transportation, "Uses and Meanings of Full Social Cost Estimates"
- Paul N. Leiby, David L. Greene, and Donald W. Jones, Oak Ridge National Laboratory, "Social Costs of Energy"
- Ted R. Miller, National Public Services Research Institute, "Motor Vehicle Crashes"
- Emile Quinet, Ecole Nationale des Ponts et Chausees, "Full Transportation Cost Estimation in the European Community"
- Donald C. Shoup and Mary Jane Breinholt, University of California, Los Angeles, "Parking: Costs, Pricing, and Effects on Mode Choice"

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